The Glass Industry
REG. U. S. PAT. OFF.
1932-1933
R666.1 V.13-14
Vol. 13 JANUARY, 1932 No. 1

Segregation of Soda Ash in Glass Batches†

By GEORGE LYNN [1]

THE problem of segregation in the glass batch has long been a subject of discussion and dispute among furnace teasers, technologists and batch material providers, but, as discovered by the author, very little information of original and authoritative character, designed to be of assistance in solving the problem, has heretofore appeared in print.

It is a pleasure therefore to present to our readers Dr. Lynn's interesting account of his carefully prepared and carried out tests. This contribution for the benefit of the industry has been made possible through the courtesy of the Columbia Alkali Company.—[Ed.]

SERIAL

ALL glass makers agree that metal of uniform composition is essential to successful glass manufacture. While convection currents in the metal as well as the agitation due to evolved gases both tend toward the attainment of uniformity, it is quite generally recognized that a batch, uniform at the time it is laid down in the furnace, is of very great importance. A search in the literature failed to reveal any quantitative information on this subject, however, and therefore the tests described in this article were undertaken sometime ago.

The results seem to possess sufficient general interest to justify publishing them to the industry. They do not pretend to comprehensiveness, but do reveal the order of magnitude of segregation. Very little investigation on the segregation of solid particles from mixtures of any kind seems to have been done.[2] This subject appears to be one of prime importance in so many industries, that extended investigation should yield valuable results.

METHOD: For these tests a simplified standard batch without cullet was used, containing 63.7% glass sand, 12.8% limestone, and 23.5% soda ash, mixed dry. Only segregation of the soda ash from the batch was determined. Since the soda ash was the only water soluble constituent, this was very easy to do, and results on soda ash would give quantitative data on the segregation of the first constituent to react in the melting of the batch. For complete tests it would be desirable to follow the segregation of all the constituents of the batch; but it seems reasonable to assume that other materials would act similar to the ash.

As a standardized procedure, the batch was thoroughly mixed through a riffle such as is used in sampling coal, until tests of random portions gave the same ash content. It was then carefully placed in a funnel with a one-inch hole at the bottom, which was closed. When the funnel was full, the bottom was opened and the contents fell sixteen inches onto a level surface, where a conical pile about 18″ diameter by 6″ high was formed. The amount of segregation was measured by determining the percentage of soda ash at various points on the axis and at the surface of the pile.

The obtaining of really representative samples for analysis proved the most difficult part of the tests. This was finally accomplished by beginning at the top and successively slicing the pile into layers parallel to the base, using two sheet metal "knives." A sample was taken from the edge and one from the center of each slice before proceeding to the one next below. This is illustrated diagrammatically in

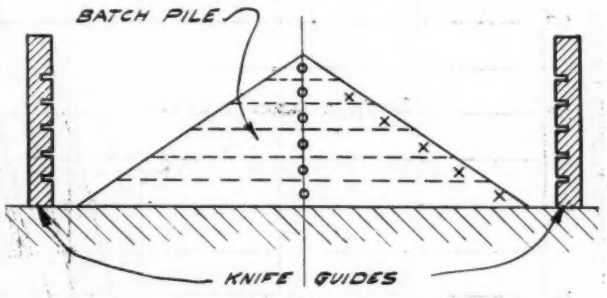

FIG. 1

DIAGRAM SHOWING SAMPLING SCHEME FOR GLASS BATCH PILE: CIRCLES SHOW LOCATION OF SAMPLES ON AXIS: CROSSES SHOW LOCATION OF SAMPLES AT SURFACE

Figure 1, which shows the guides used with the "knives" when slicing a pile of batch.

MATERIALS: In order to tie the findings in with plant practice, samples of limestone and of sand were obtained from nine different glass plants. The screen analyses of these materials are given in Tables 1 and 2 respectively. These analyses are shown graphically in Figure 2 and Fig-

†Copyright, 1931, by George Lynn.
[1] Research chemist, Columbia Alkali Corporation, subsidiary of The Pittsburgh Plate Glass Company.
[2] About the only worthwhile article found was one by Chas. Catlett on "Segregation as it Applies to Tanks as Segregating or Mixing Devices." Concrete (Cement Mill Section) 20: 95-100 (1922).

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ure 3 respectively, in which cumulative percentages on the screens are plotted against the logarithm of the screen openings. In a similar way the screen analyses of seven soda ash samples are given in Table 3 and Figure 4.

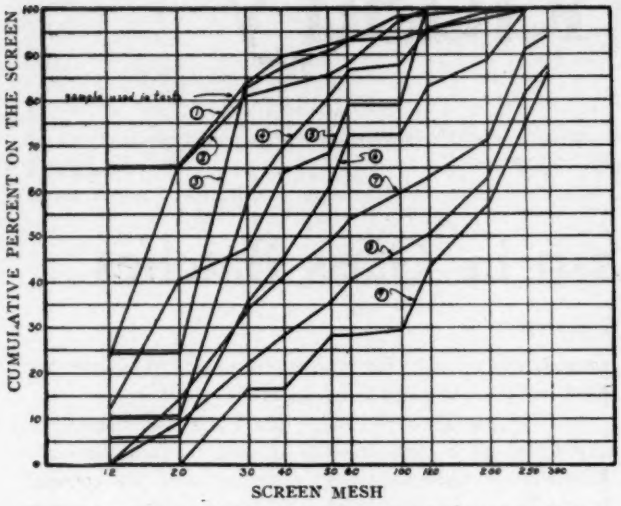

FIG. 2—SCREEN ANALYSIS OF LIMESTONES FROM NINE REPRESENTATIVE GLASS COMPANIES

TABLE 1
Screen Analyses of 9 Limestone Samples. (See Fig. 2)

Sample	1*	2	3	4	5	6	7	8	9
Mesh	Percentage on Screen								
12	23.2	65.4	24.4	10.6	11.7	6.0	0.3	0.2	0
20	42.5	0	0	0	29.2	0	13.8	8.9	0
30	18.1	16.2	58.6	48.7	6.9	29.9	20.1	13.0	16.7
40	5.1	1.6	4.2	10.6	17.3	9.8	7.1	6.4	0
50	4.4	3.7	3.8	10.9	3.9	16.2	7.9	7.4	11.6
60	4.9	2.1	2.1	6.3	10.5	10.4	4.9	4.8	0
100	0	9.5	0.2	0.8	0	0.7	1.5	1.0	1.5
120	1.8	1.5	2.6	7.8	20.8	10.7	8.8	9.0	14.1
200	....	....	2.0	3.5	....	5.7	8.4	12.4	13.6
250	....	....	2.1	0.8	....	10.6	19.6	19.3	25.3
300	....	....	....	....	....	....	2.4	5.1	3.9
Thru 300	....	....	....	....	....	....	5.2	12.5	13.3

*Sample used in tests.

TABLE 2
Screen Analyses of 9 Sand Samples. (See Fig. 3)

Sample	I	II	III*	IV	V	VI	VII	VIII	IX
Mesh	Percentage on Screen								
20	0	0	0.2	0	0	0	0	0	0
30	30.6	15.4	10.2	5.9	7.9	1.8	3.2	2.0	0.3
40	40.9	35.0	23.3	13.8	11.2	14.0	16.9	9.5	1.8
50	21.2	39.0	42.8	43.1	33.8	37.2	53.3	37.3	14.6
60	4.3	9.0	15.3	23.2	27.8	23.7	19.9	30.4	26.4
100	2.5	1.1	7.1	10.8	15.1	19.8	6.4	17.6	46.4
120	0.1	0.5	1.1	0.6	0.7	1.1	0.3	3.2	3.6
200	0.3	....	....	2.1	3.0	2.3	....	....	6.4
Thru 200	0.1	....	....	0.5	0.5	0.1	....	....	0.5

*Sample used in tests.

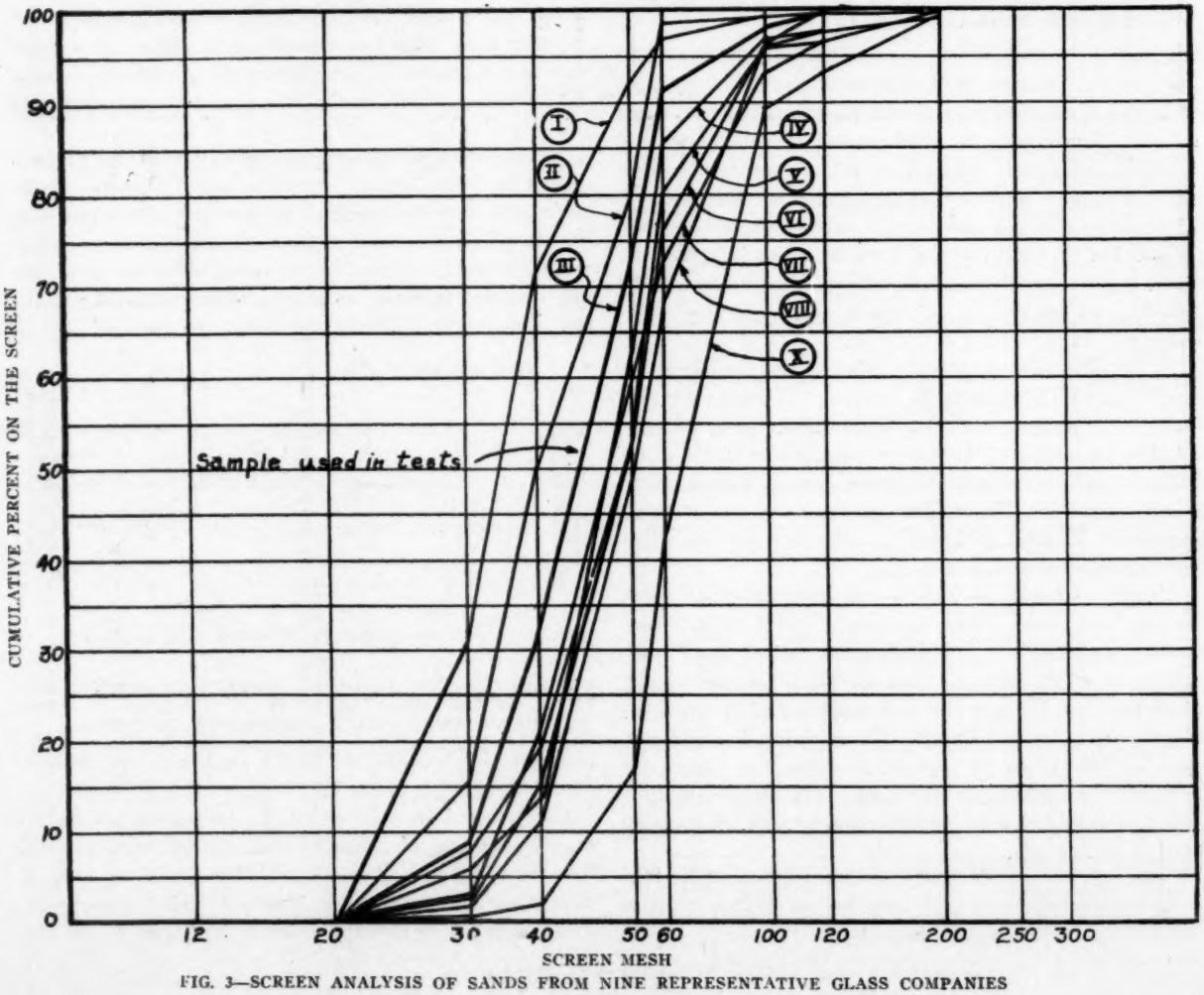

FIG. 3—SCREEN ANALYSIS OF SANDS FROM NINE REPRESENTATIVE GLASS COMPANIES

For the first eight tests the sand indicated in Figure 3 was used; this is fairly representative of all the sands. For the first seven tests the limestone indicated in Figure 2 was used. Ash of different screen analysis was used in each of the tests, as follows: For test No. 1, ash "a" (Fig. 4) was used; for tests No. 2 and No. 3, ash "b" was used; for test No. 4, ash "d" was used; for test No. 5, ash "f"; for test

(Continued on page 4)

TABLE 3

Screen Analyses of 7 Soda Ash Samples. (Fig. 4)

Sample	a	b	c	d	e	f	g
Mesh	Percentage on Screen						
30	71.3	62.6	11.6	21.6	0	19.7	0
40	....	....	21.2	....	....	....	....
50	23.8	35.0	41.0	37.5	35.6	17.2	0.7
60	....	....	17.4	....	....	....	....
100	4.0	2.6	7.0	32.6	51.6	34.6	53.3
120	0.3	0.2	1.8	2.5	2.4	6.5	13.5
200	0.3	0.2	....	4.6	6.2	16.7	22.0
Thru 200	0.2	0.6	....	2.0	3.2	6.7	9.2

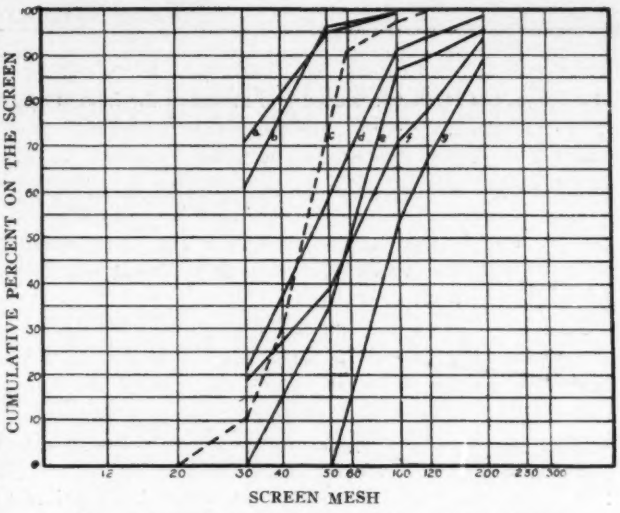

FIG. 4—SCREEN ANALYSIS OF 7 SODA ASH SAMPLES

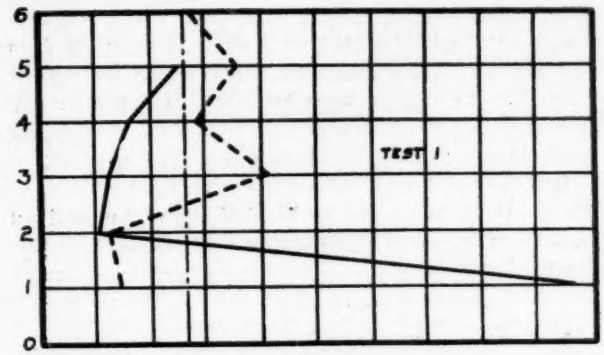

FIG. 5

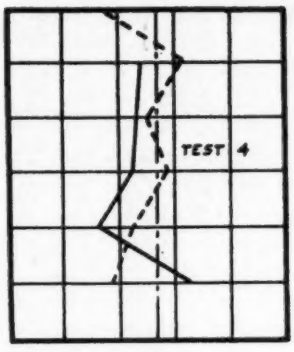

FIG. 8

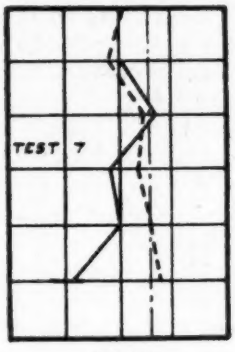

FIG. 11

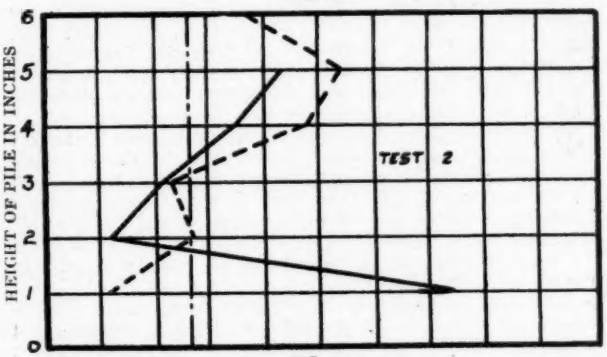

FIG. 6

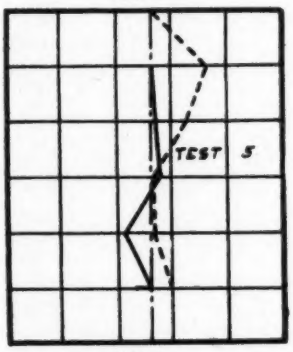

FIG. 9

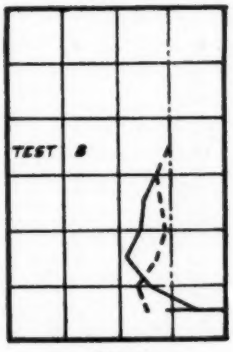

FIG. 12

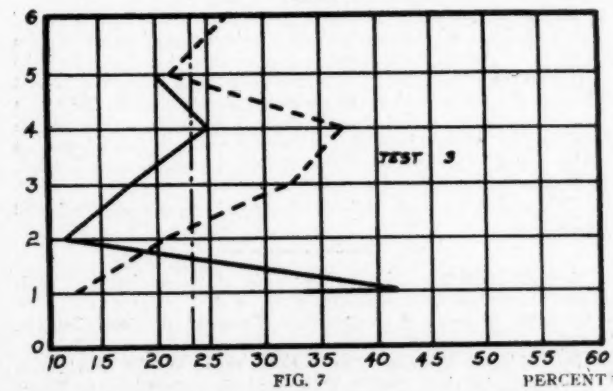

FIG. 7

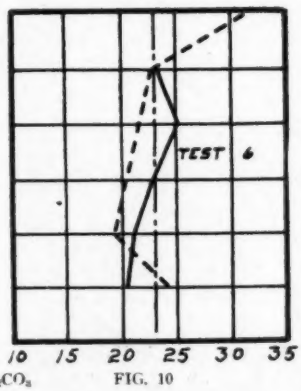

FIG. 10

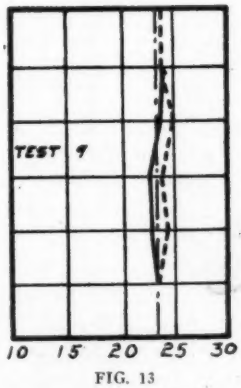

FIG. 13

SEGREGATION AT VARIOUS POINTS IN THE PILE
– – – – CENTER ——— EDGE

FIGURES 5-6-7: Segregation in a batch using coarse soda ash, showing about four times as much soda ash at outside base of pile as occurs one-third up the pile.

FIGURES 8-9-10: Less segregation occurs when finer soda ash is used.

FIGURE 11: With soda ash considerably finer than the sand, a deficiency of ash occurs at the lower edge of the pile.

FIGURE 12: Segregation occurring in a soda ash—sand batch of practically identical screen analysis.

FIGURE 13: A batch with all constituents through a 30 and on a 50 mesh screen, shows very little segregation.

No. 6, ash "e", and for test No. 7, ash "g". In the case of test No. 8, the ash was screened and mixed in the laboratory so as to duplicate very closely the screen analysis of the sand; how closely this was accomplished is shown by a comparison of ash "c" (Fig. 4) and the sand indicated in Figure 3. Sand and ash only were used here in the proportion of 75% sand and 25% ash. For test No. 9, sand, ash, and limestone which went through a 30 but was retained on a 50 mesh sieve were used.

RESULTS: The results are shown graphically in Figures 5 to 13 inclusive, in which the height (in inches) of the sample in the pile is plotted as ordinates against the percentage of ash as abscissae. The dotted lines connect points representing the composition of samples from the axis of the pile; continuous lines connect points representing the surface of the pile. Had no segregation occurred, all points would have fallen on the vertical dot-and-dash lines.

DISCUSSION: It is obvious from tests No. 1, No. 2, and No. 3, which were run with very coarse soda ashes, that the coarse ash had a tendency to run to the edge of the pile and thus accumulate around the lower edge of the pile. There is a large surface deficiency just above the base of the pile, and this deficiency tends to diminish toward the top. There is a deficiency of soda ash at the center of the base, which tends to become an excess about two-thirds of the way up.

The maximum excess of soda ash is roughly 100% of the ideal; the greatest deficiency is about 50% of the ideal. In other words, there are places in the batch which may have twice the soda ash content expected and others with only one-half the expected amount. This means that there may be a variation of four to one in the percentage of soda ash at various places in the batch, under the conditions of these tests. Just what the segregation would be in a plant using a coarse ash such as these, would depend on the batch handling layout at that plant.

Tests No. 4, No. 5, and No. 6 were run with ashes of intermediate screen analysis, and showed less segregation. Test No. 7, run with the finest sized ash, showed segregation in the opposite sense, there being a deficiency of ash in the lower edge of the pile.

These results seem to indicate that a batch, all of whose ingredients have the same screen analysis, would best best. Test No. 8 was made especially to test this point out. Soda ash "c" (Fig. 4) was made up especially so as to duplicate almost exactly the screen test of the sand, and a mixture of 25% of this soda ash and 75% sand was used. The results show the same tendency as found with a coarse ash in tests No. 1, No. 2, and No. 3, though of lesser extent, namely, an increase at the bottom edge and a decrease in the surface above the bottom. This would seem to indicate that an ash with somewhat more fines than the sand would be better than one exactly like the sand. This indication is borne out by tests No. 5 and No. 6. This effect is probably due to the differences in absolute density and in coefficient of friction of sand as compared with soda ash.

Theory would predict, and these tests indicate, that an ideal batch would be one in which all the particles of all the constituents were alike in every respect. This is, of course, impossible since differences in shape, density, and surface characteristics are inherent in the materials. In order to approach ideal conditions somewhat, test No. 9 was run using all constituents screened through a 30 and on a 50 mesh. The results bear out the theoretical predictions, there being very little segregation indeed.

Of the four factors influencing segregation, namely, particle size, particle shape, density, and surface characteristics of the particle, size seems to be the controlling factor here. The finer the particles, the less the segregation, but very fine particles cause dusting and excessive stack losses from the tank. Furthermore, it is not very feasible to consider grinding the sand finer than it naturally occurs.

CONCLUSIONS: In practice, since the sand is the principal batch constituent and is in general already sized by nature, it seems, from the results of these tests, that best plant practice would call for screen specifications on the limestone and soda ash, conforming fairly closely to that of the sand actually used in each plant. The limestone samples received from the nine plants deviate widely from this criterion. These tests indicate that a soda ash slightly finer than the sand is preferable. It is obvious also that good plant practice is to eliminate, in so far as possible, all batch handling operations where segregation can occur.

It is desired here to acknowledge the excellent work of Messrs. O. C. Moyer and D. W. Peabody, who worked out methods of analysis and made most of the actual tests here described.

New German Handbook Covers Glass Exhaustively

Glastechnische Tabellen (Tables for Glass Technology), a new work edited by Prof. Dr. W. Eitel, Prof. M. Pirani and Prof. Dr. K. Scheel on behalf of the Deutsche Glastechnische Gesellschaft (German Society for Glass Technology) and with the collaboration of several other prominent scientists is announced by V. D. I. Buchhandung, Ingenieurhaus, Berlin, Germany.

Technical and physical research in the field of glass production, aiming especially at determining, not only the viscosity of glasses, but also their mechanical and thermal properties, resistance to chemical action, etc., has of late made such strides that a general handbook giving the physical and chemical constants, such as the Landolt-Börnstein Tables or the International Critical Tables, is no longer of sufficient scope to cover all the material available as the result of glass research.

Nevertheless the glass technologist needs such a book. For this reason, the tables on the physical and chemical constants, just announced, have been compiled. They will, the publisher states, meet all demands of modern glass technology.

The work gives an exhaustive account of the present state of our knowledge of glass technology. It is divided into three main sections, of which the first contains a general classification of the glassmaking materials. The second section presents the special data of physical and chemical constants, in other words, the tables proper, while the third section gives a complete survey of the composition of all kinds of glass that have been investigated, it being stated in each case whether the ingredients have been determined by synthesis or analysis.

The price of the book, in Germany, bound in cloth, will be 149.80 marks.

A LAMP CHIMNEY, said to give a glow of greatly increased brilliancy compared with the older types, is now being produced by the Kerr, Hubbard & Kelly Glass Company of Sand Springs, Okla.

The chimney has the same general shape as the usual type, except that its sides contain large vertical corrugations or indentures, which expose more of the glass surface for reflection. It is described as the first real improvement in lamp chimney manufacture in 20 years.

The Causes and the Prevention of Explosions In Silvering Glass

By JACQUES WOLF[1]
Formerly Managing Director of Mirror Factories

EVERY expert, in mirror manufacture, knows that when silvering glass by most of the modern chemical processes, he has constantly to fear explosions. Indeed, most of them know by experience the enormous power and violence of these explosions which sometimes destroy installations and cause terrible accidents. Very little has been written about these phenomena, yet in reality, such explosions occur quite frequently, and indeed much too often, considering the fact that they can be absolutely avoided.

The explosion of silvering solutions is always a consequence of a failure of workmanship. The silvering of glass is purely a chemical process, and must be carried out according to certain prescriptions with which, the expert, through practical experience, is completely familiar, without, however, having a thorough knowledge of the chemical reactions and the why and wherefore of the different processes of his work. Frequently, mirror operators try to diminish the number of manipulations, in order to speed up, modify and simplify the work. This may be a very good principle in other industries, but in the silvering process this practice entails great danger.

In order to understand the utility of the different manipulations in silvering, it is necessary to know the significance of all of them. A short recapitulation of the actual process will therefore be desirable. The silvering of glass in the manufacture of mirrors and looking-glasses has, up to the last decade, been carried out by means of the so-called tartaric acid process which was discovered in 1856 by Petitjean and which through the nature of its components causes no explosions whatever. The sugar processes, however, present certain advantages from an industrial point of view, so that they have supplanted to a large extent the processes taking tartaric-acid as a reducing agent.

The chemical principle of glass-silvering by means of the sugar process is the reduction through the application of sugar of an ammoniacal silver solution to a metallic silver layer. The practical execution of this principle presents no little difficulty. The sugar generally used is beet or cane sugar. These are highly molecular compounds, which are not capable of bringing about the necessary reduction and so must be divided up to a simpler compound. It is, therefore, first, necessary to decompose the complicated sugar into simple sugar. This is done by boiling the sugar solution with concentrated acids, whereby the cane sugar, with addition of water, crumbles into its compounds the less complicated sugar, the fruit and grape sugar.

In this process, the silver solution itself is an ammoniacal solution of silver nitrate. The sugar reduction acts only slowly in an ordinary alkaline solution and so needs a caustic alkaline solution in addition to the ammoniacal silver nitrate. Caustic alkaline solutions generally have a tendency to a higher chemical activity. Under the influence of physical agents such as heat and light, they give reductions and combinations sufficient to alter the processes.

It is, therefore, desirable to preserve all alkaline solutions in brown bottles in dark and cool places. When joining the alkaline to the ammoniacal silver nitrate solution, the silver nitrate-ammonia $Ag(NH_3)_2$ will be transformed into silver hydroxide-ammonia

$$Ag(NH_3)_2NO_3 + NaOH = Ag(NH_3)_2OH + NaNO_3$$

(Ed Lohmann) and sodium nitrate. However, when the solution by evaporation or mistake has become too concentrated, this silver hydroxide-ammonia, $Ag(NH_3)_2OH$, has a tendency to decompose itself into ammoniac, water and silver amide. From the latter ($AgNH_2$) a part will be decomposed into ammonia and silver nitride (Olmer). In this way in the solution will be found the mixture of silver amide and silver nitride. This silver oxide-ammoniac is very explosive, as is also the silver nitride, called "Berthollet's fulminating silver," after its inventor, and which has a great explosive power. Even when the material is wet, the slightest touch may cause an explosion. It is, therefore, clear that this mixture, formed in a concentrated solution as a brown-black flaky sediment, is extremely dangerous. A bottle containing such a solution will explode at the slightest touch with a force exceeding many other explosive materials. A room where such an explosion has taken place, will be found to have the walls and furnishings covered with a nearly invisible powder of this fulminating silver that will, even after several weeks, crackle loudly when touched. However, the formation of the explosive precipitate is only possible when the solution has exceeded certain limits of concentration.

The ammoniacal silver nitrate solution used for silvering purposes must always be very dilute, and the concentration is much below the above mentioned limits. To avoid an explosive mixture, a separate storage of ammoniacal and alkaline solution is therefore a main condition. They may be put together a little time before using and in a very diluted solution only. It is to be borne in mind that caustic alkaline solutions always have a certain tendency to a higher chemical activity, especially when acted upon by heat and light, which in a short time cause strong chemical reactions. It is, therefore, necessary even before the mixing to preserve the alkaline solution in brown bottles in a dark and cool place.

It is to be noted that the silver nitrate ammoniacal solution may become explosive also, though not in such a dangerous way, when it has become concentrated. Consequently it must not be prepared too long before using.

[1] Belgium.

The explosions that occur most frequently when silvering mirrors, are those caused by the formation of silver amide and fulminating silver.

Besides these explosions of a purely chemical nature, explosions occur from time to time owing to a wrong method of working; for instance, as mentioned below under rules 7, 8 and 9 "Carelessness In Mixing the Undiluted Solutions," or by forgetting a part of a solution that had not been used at once and that had been put aside for days, so that the greatest part of the liquid has evaporated. In case the formation of the precipitate has already taken place it is possible to dissolve it by merely adding fresh ammonia. This is a dangerous operation and before touching the bottle or pouring the liquid, it is most advisable to protect the eyes with safety spectacles.

Considering the fact that explosions in silvering mirrors are of rather frequent occurrence, it is very desirable that every workman in the laboratory should be aware of the danger of the precipitate, so as to inform the foreman of dangerous conditions as soon as possible.

The measures to be taken in order to avoid explosions are as follows:

1. The ammoniacal silver and alkaline solutions must be prepared *separately* and diluted.
2. Solutions must *never* be mixed in a concentrated condition, but only *after* each has been diluted according to the prescribed proportions of the process.
3. The silvering fluid must be protected against sunlight and be kept in brown bottles in a cool place.
4. The silver solution may be prepared beforehand *no more* than one or two days at most; the alkaline solution may be allowed to stand longer.
5. The mixing of the two diluted solutions may only take place *immediately* before use of the liquid.
6. When mixing the two diluted solutions a thorough mixture may be had by shaking well.
7. The alkaline solution must always be poured *into* the silver solution, but *never* conversely.
8. For the preparation of the reduction liquid the concentrated acid must always be carefully poured *into* the silver solution, *never* conversely.
9. Silver nitrate must *never* be poured *into* the ammonia when preparing the silver solution, but the ammonia must be poured carefully on the nitrate.

The Manufacture of Rolled Plate

By ERNST LUTZ *

(*Continued from the December, 1931, issue*)

This work has been revised, so far as the English and the technical expressions are concerned, by F. W. Preston, who has also added a number of notes relating in general to the special conditions of American practice; but it must be understood that the opinions expressed in the text are those of Mr. Lutz, and neither the Editor nor Dr. Preston accepts responsibility for them.

ACCORDING to German patents, 319,989 and 333,559 of Feb. 14, 1919, granted to Michael Pesch and the Spiegelmanufaktur Waldhof A.G., the polishing blocks near the center are suspended on a separate runner, which can be retarded or even driven backwards, while the outer angular crown is moving with the table in the ordinary way. The inner runner is driven backwards by the outer. With such a polishing apparatus the eccentricity can be so set that the most favorable polishing effect is obtained at the table edge while the corresponding deficiency in the middle is counteracted by the backwards drive of the inner runner.

During the polishing with these machines the polishing blocks turn fairly quickly round their guide pins. The closer the felt is in contact with the glass the faster this movement. Figs. 162 and 163 illustrate a polishing block of about 30″ diameter designed for such a polishing machine. The cast iron plate 1 is located in the cast iron casing 3; onto it ¾″ to 1″ thick felts are fixed by a press and held by the tight-fitting rings 2. Two symmetrically arranged levers 4 and 5 prevent the connection between plate and casing getting loose. The suspension and guide pin 7

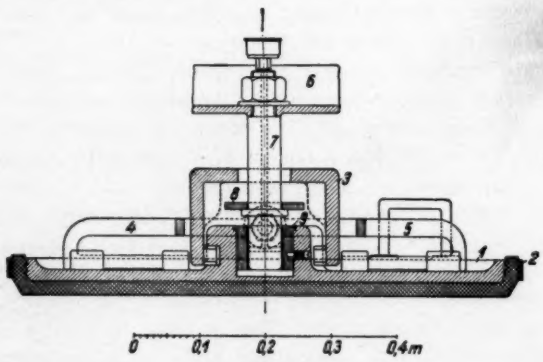

FIG. 162

screwed onto the polishing runner 6 carries a disc 8, which, when the crown is lifted, also causes a corresponding movement of the casing 3 and the polishing block. During the polishing, i.e., when the crown is lowered and the blocks are resting on the table, the sleeve 9 thrusts against a collar

* Of Desseau, Germany. This work is appearing in German in the new edition of *Dralle-Keppeler*, "Die Glasfabrikation."

FOOTNOTE: In the Figures, originally prepared for use eventually in the new edition in the German language of *Dralle-Keppeler*, "Die Glasfabrikation" in 1931, dimensions are given in metres (*m*) and millimetres (*mm*). We would like to have given these in feet and inches but the translation and the making of nearly two hundred and fifty new illustrations would have involved a prohibitive loss of time and expense. To some of our readers the metric system is as familiar as the English units; for the others we may say that a metre is approximately 40 inches, and a millimetre is approximately 1/25 of an inch. A thousand millimetres, of course, go to a metre.—*F. W. P.*

of the bolt 7. As mentioned before, the whole polishing block turns fairly quickly round the pin, the lower part of which has to be well hardened. Provision must also be taken for a sufficient lubrication of the bushing 9. The polishing block in all of its parts must be designed symmetrically so that no one-sided centrifugal forces arise, which

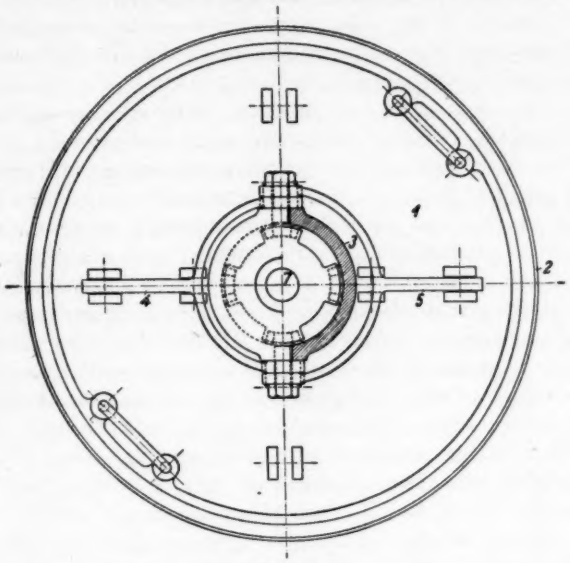

FIG. 163

would be detrimental to the polishing effect and cause uneven wear of the felt and the bushing 9. For this reason two levers 4 and 5 are provided, although one would actually suffice. The polishing effect is greatly influenced by the ratio of the weight of the polishing block to the area of the felt surface. With a thickness of the plate and the casing body of about 5/8" to 3/4" the weight of the block will generally be sufficient; in many factories, however, the casings

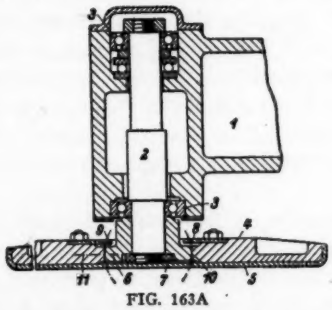

FIG. 163A

are made somewhat heavier by giving them a form as shown in dotted lines in Fig. 162, or alternatively a number of lead blocks are screwed to the plate. For the changing of a felt nothing but the two levers 4 and 5 have to be operated and the cast iron plate can then be unfastened from the casing by a sharp jerk; the casing together with the two levers is then left behind, suspended on the bolt until a new plate is inserted.

These polishing machines (System Delloye) with a single runner had up to the present given the best polishing effect. Assuming an equally good "smoothing" beforehand in the grinding apparatus and otherwise equal conditions, they work almost twice as fast as machines with frames as shown in Figs. 155-157.*

Fig. 163 A shows a polishing block according to U. S. patent 1,687,959 of F. B. Waldron, assignor to Pilkington Brothers, Ltd., Liverpool, England. The polishing block 4 covered with felt is suspended by means of the removable plate 8 in the boss 6 which is attached to the lower end of the axis 2. The shoulder 9 of the boss 6 has a periphery which is curved to a portion of a sphere, while the block is bored cylindrically. Thus, the boss 6 contacts with the block 4 only along a line so that the block may tilt freely on the boss. According to the patent, this line of contact is approximately in the horizontal plane passing through the center of gravity of both the block 4 and its felt, as indicated by the dotted line 11. It has been mentioned previously that it is advantageous for the obtaining of a good polish that the blocks rotate on their own axes. This rotation is indeed caused by reason of the relative velocity between glass and polishing block which is greater at points more distant from the axis of the runner frame than it is at points nearer to it. Furthermore, the polish becomes the better the more uniform is the pressure of the felts on the glass all over the face of the polishing block. If the line of contact between the boss 6 and the polishing block is above or below the center of gravity of the block, the latter may be tilted thus injuring the free rotation on its own axis and the uniform spreading of the pressure of the felt on the glass.

The construction shown by Fig. 163 A is adaptable only for runner frames of relatively small diameters, as for instance, for the runner frames of straight polishing lines with rectangular tables. Runner frames with large diameters have by reason of their inevitable error considerable amplitudes of wavering at their peripheries; therefore, the boss 6 must have a longer movement in the block. Neither is it advantageous if the boss 6 or the lower end of the axis 2 push against the upper side of the felt 5; nor, if the bore of the block goes all through so that the felt is suspended at that point instead of sitting close to the whole surface of the block.

Another example for the mounting of a polishing block is found in Fig. 135 Q.

The Continuous Principle

"The continuous principle was adapted to the grinding and polishing process as follows: Instead of bringing single circular tables covered with glass under the grinding and polishing apparatus, one by one, rectangular tables were joined at their short sides to one endless string, thus forming the grinding and polishing line. The tables slide on rails and wheels, or better, on accurate guides much the same as are used for the precise guides of machine-tools such as planing machines. Above the line of tables the grinding and polishing heads are mounted successively. While on the round tables the same tool has to grind in succession first coarse and then fine, on the continuous line at least one tool is assigned for each grade of sand, or in other words the same tool works always the same grade of sand

* Not necessarily a single runner?—F. W. P.

or rouge respectively, consequently always doing the same sort of work.

"The tables joined to the endless line and covered with glass travel under the grinding and polishing apparatus to the finishing end of the line. There the glass is taken off and the empty table detached from the series and returned underground or sidewise to the same line (Figs. 135 A, 135 B, 135 C and 135 D), or the table joins a line which runs parallel to the first line in the opposite direction. Figs. 135 E, 135 F, also 244 and 245 (to appear later).

Grinding and polishing lines are constructed in widths up to 15 ft. and lengths up to 1,000 ft. or more. As the tables are joined accurately in one line the glasses may be laid over the joints, thus permitting greater liberty in the choice of sizes of the rough glass and resulting in a minimum of waste.

"The scheme of the rolled plate glass plant of the Ford Motor Company is shown by Fig. 244. From this figure may also be seen how extremely clever and space saving is the way by which tank furnace, annealing oven and grinding and polishing line are built together. How far this concentration goes may be seen from Fig. 135 G, showing the annealing oven and sand grading arranged directly sideways above the grinding and polishing line. Ford produces but small continuous sheets of about 42" width. Consequently, the grinding and polishing line is about 42" wide, too. The single tables run on rolls. It is very difficult to construct rolls and rails as accurately as the continuous process requires for complete success. Slight movements of the tables easily cause poor results in the fine grinding at the joints. Fig. 135 H shows a polishing tool of the Ford Motor Company. The polishing blocks as such are similar to the polishing apparatus with round tables. They consist of iron discs to which the felt is fastened by an iron ring. The feeding with rouge is done automatically and controlled by electrically controlled valves.

"The system of grinding and polishing in use by the Ford Motor Company was designed particularly for tables of small widths and exclusively constructed for the manufacture of automobile glasses particularly windshields. The Pittsburgh Plate Glass Company, however, as a manufacturer of large show window glasses, developed the system for the manufacture of large sheets. Accordingly, the apparatus had to be at least 10 ft. wide. No difficulties arose from this extension as far as the grinding was concerned but the polishing caused difficulties. The grinding could easily be arranged in the continuous process; the successive working of the surface of the glass with different grades of sand can be executed even better continuously than noncontinously. When using grinding machines with circular tables and the same heads for all grades of sand, there is always the risk that residues of the coarse sand may stick to the runners in spite of thorough washing and later on may get loose during the process of smoothing thus spoiling it. This would not happen with the continuous grinding line as each tool works with the same grade of sand all the time. One just has to adjust scrapers to avoid the misplacing of the different grades of sand.

"It was not as easy to make the polishing process a continuous one too. The polishing is done by the circular apparatus as follows: Before the operation begins, the felts are washed thoroughly before they are gradually supplied with rouge thus exerting on the surface of the glass in the beginning a scraping and later on a rubbing effect. The last polish is conferred on the surface as the rouge is drying more and more, at last working with but a thin layer. This is limited by the point where the rouge becomes caked. These cakes may get loose, come under the felts, and spoil the polish with so-called polishing sleeks. The washing at the beginning of each polishing process is to remove the caked rouge from the felts. The continuous polishing line does not permit offhand for the alternating working and washing of the felts. Therefore, the danger of incrustation of the felts and polishing sleeks constituted the most important problem in making the polishing process a continuous one. The difficulties were overcome in different ways. For the narrow tables of the Ford Motor Company it was an easy matter because all of the felts frequently come over the edges of the narrow tables and are so cleaned by scraping. Further, automobile glasses do not need so fine a polish as store front windows and sheets to be silvered. Therefore, the problem is of much greater importance to a polished plate glass manufacturer than it is to an automobile builder like the Ford Motor Company.

"The Pittsburgh Plate Glass Company solved the problem by installing the runner frames of their polishing apparatus so that they can be exchanged or tilted easily as described in the U. S. patents 1,501,327 of John H. Fox, and 1,548,105 of Jacob Soderberg. After a certain period of time has elapsed, each of the runners is either tilted and the individual felts are cleaned by scraping or the whole runner frame is removed by a crane and exchanged for a freshly cleaned one.

"A different system was developed by the firm of Pilkington Brothers, Ltd., the European pioneers of the continuous grinding and polishing line. According to U. S. patent 1,781,226 a truck carrying a pan made of tin is installed aside the line of tables. The polishing blocks are raised and the washing pan is pushed between the felts and the tables; then the runner frame is lowered and the felts washed by rotating on the tinplate and being watered at the same time.

"Another solution of the problem is found in the U. S. patent 1,582,808 of L. von Reis. The polishing machines travel in the same direction as the glass tables but with a slower motion. When they have arrived at the finishing end of the line of tables, they are taken off and automatically cleaned, whereupon they are returned and started anew at the starting end of the polishing process. The scheme of this is shown in Fig. 135 J.

"Fig. 135 F shows the continuous grinding line used by the General Motors Company (National Plate Glass Company's plant, lately acquired by the Libbey-Owens-Ford Glass Company) where the felts are cleaned according to the L. v. Reis patent. This equipment consists of two parallel lines of tables about 750 ft. long running in opposite directions. The tables are about 15 ft. wide and 13 ft. long, and travel forward on the first line and, at the

finishing end, the glass which is ground and polished on one side is taken off. Then the tables are pushed over a sliding platform (seen in the foreground of the figure) to the second line of tables which travels backward, and the glasses are re-set with the polished sides down. In the figure the guide-ways of the tables and, at the right, the automatic washing device for the polishing felts can be recognized.

"While the constructions of the Ford Motor Company and of the Pittsburgh Plate Glass Company employ but one single grinding and polishing tool for the entire width of the glass to be treated, the constructions built according to the Pilkington and Heuze patents use several tools coordinated side by side. This arises from the great width of the tables. The working of so large a glass with one single tool would require a too big and too heavy tool. Therefore, several working tools are installed side by side in some such way as described in the German patent specification 375, 925 (Figs. 134 and 135). In order to make the distribution of the working of the glass surface more uniformly spread over the entire width of the table, the holder of the tools gets a simultaneous oscillating motion. The uniformity can also be improved by the construction of oval tools (Fig. 135 K,. grinding tool of the continuous grinding line of the Herzogenrather Glaswerke) or by displacing the shafts of the tools with respect to each other. (Figs. 135 L and 135 M.) The latter figure shows the working curve of two polishing blocks. From this curve, the effect of the displaced shafts can be seen.

"Although the development of the continuous grinding and polishing line is not yet quite 10 years old, these machines have been introduced very quickly into the polished plate industry and taken the place of the old rotating polishing apparatus. The apparatus, with tables of up to 15 ft. widths and lines of more than 1,000 ft. lengths, the weights of some of these machines exceeding 3,000 tons, represent giant plants the dimensions of which come near to those of large modern steel works and rolling mills.

"The grinding and polishing processes have been improved until an excellent quality of finish has been achieved and this with a much greater constancy than was secured previously by the old rotating apparatus. The travelling speed of the tables and the output of the grinding and polishing constructions depends, of course, on their lengths. An extensive line of tables with many grinding and polishing tools can work considerably faster than a short line. The customary speed lies between 100 ft. to 300 ft. per hour, i.e., the output that can be obtained is from 2 million to 20 million square feet per year, depending on the width. The continuous grinding and polishing apparatus being a means of mass production shows considerably better results in large units than in small.

"Details of the theoretical working conditions and polishing may be obtained from the report 'Arbeitskurven der Werkzeuge bei Spiegelglas-Schleif-und Polierbahnen' ('Working curves of the tools in rolled plate glass grinding and polishing lines') which was given by Dr. Ing. Thomé, Aachen, at the 14th glass technical meeting of the Deutsche Glastechnische Gesellschaft from November 13 to November 15, 1930, in Berlin. This report has been published in the *Glastechnische Berichte* der Deutschen Glastechnischen Gesellschaft in Frankfurt/Main."

As regards the above mentioned U. S. patents 1,501,327 and 1,548,105 of the Pittsburgh Plate Glass Company and 1,582,808 of L. von Reis the following may be added: In the introduction to the chapter "The grinding and polishing of the rough glass" and later, on different occasions, it had been pointed out that the polishing felts become greasy while they are used and encrusted from rouge and sometimes are filled with glass splinters; and that therefore frequent washing and cleansing of the felts is indispensable if a good and unimpaired polish is to be secured. As stated in the above report, this necessity of washing and cleansing the felts at first constituted a great obstacle to the carrying through of the continuous polishing process; it must be added that the felts wear out in a relatively short time and, therefore, must be renewed frequently. Thus it was of greatest importance upon the introduction of the continuous grinding and polishing lines to find ways of inspecting, cleansing and exchanging the felts without disturbing the continuity of the work.

According to U. S. patent 1,501,327 (Figs. 135 N and 135 O) the requirements are met through the suspension of the entire runner frame 13 in such a way that it can be tilted easily into an inclined position as indicated by the dotted lines in the figure. In this position the lower surfaces of the runner blocks can be examined easily, scraped, and cleaned, and every single block can quickly be supplied with new felts, if necessary. Paralleling the line of tables, a truck is located on a runway carrying a washing table 30 the plate of which is formed similar to a pan and can be slid under the tilted felts in order to protect the glass and the neighboring parts of the apparatus from dirty water, from hard crusts, glass splinters, etc., that must be removed. The truck carrying the washing table carries, not only the water used for the washing, cleansing tools, such as, brushes, scrapers, etc., but fresh polishing blocks and various tools needed for exchanging them.

The rotating and suspending shaft 10 of the runner frame 13 is journalled with its upper and lower ends in the tubular support 9 which is suspended above with the trunnions 17 in the forked lever 15. The forked link 23 is provided with grooves 26 acting as guides for the trunnions 25 at the lower end of the support 9. Lever 15 and link 23 rest at 18 and 24, respectively, in the bracket 2 which is adjusted to the main framework. In order to keep the runner frame 13 in a secure working position, i.e., to keep the shaft 10 and the tubular support 9 in their vertical positions, the trunnions 25 are held against outward movement in the grooves 26 by means of the two cap members 33 fixed to link 23. Before the runner frame is swung around the trunnions 17, it must be lifted by means of the hand wheel 22, the threaded spindle 20 and the lever 15. After the two cap members 33 have been released, the runner can be swung to the right into the position as indicated by the dotted lines. It is held in this position by means of the trunnions 25 which are hooked by the two latches 36 adjusted to the end of the link 23. In the two figures, the

numeral 3 indicates the table carrying the glass to be polished, 11 the electric motors driving shafts 10 through the intermediary of reduction gearing located in the casing 12.

The U. S. patent 1,548,105 (Figs. 135 P, 135 Q, 135 R) attains the desired effect by adjusting every single block 47 to the runner frame 33 in such a way that it easily can be swung alone into the inclined position. The spindle 48 of the block 47 rotates in a pair of bearings 50 and 51 to which the links 53 and 54 forked at their ends are pivoted. The links 53 and 54 are also pivoted to the runner frame 33. If the block is to be swung outwardly, the bolt 57 is pulled out and the loosened end of the lower link is fastened with the bolt to the hole 58 of the runner frame. Thus, the inclined runner holds itself in a certain position. If another position is desired a piece of wood 57 may be put between.

This method of construction has, at the same time, the advantage that the felts, in spite of possible tiltings of the runner frame, are permitted to keep constantly in parallel relation with the glass surface, for the runners 47 are attached to the runner frame in such a way that they can freely move up and down in vertical direction. In order to make the movability of the runners a perfect one, they are connected to the spindles 48 by the ball joints 49. However, the fact that the runners are mounted in the runner frame by means of pairs of links, permits for a convenient regulation of the pressure the felts apply to the glass. By reason of the centrifugal force the links tend to keep in horizontal position. When the runner frame is lowered (Fig. 135 S), this is followed by an increase of the pressure which was previously caused by the weight of the block with its spindle and all its other parts. When, on the other hand, the runner frame is raised from normal position, the pressure is decreased. (Fig. 135 T.)

As can be seen from the pictures, the tilting devices of the patents described above can be installed advantageously only if the main frameworks which hold the runner frames are one-sided thus permitting access without hindrance from the other side. If the frameworks are double-sided, as for instance, in Fig. 129 (illustrating continuously-working apparatus for grinding and polishing built by Hooven, Owens, Rentschler Company, Hamilton, Ohio), the tilting devices cannot well be used, nor are they convenient with very wide tables as may be seen in Fig. 135 B. For continuous polishing lines of this type the problem was solved in a successful way by U. S. patent 1,582,808. The solution found by this patent can be easily understood from Fig. 135 J and the explanations given there. One advantage of this solution is also that one may take one's time for the cleaning and exchanging of the felts without being obliged to defer noticeably the work on some point of the polishing line.

The Laying Shop

Of fundamental importance for quick and economical grinding and polishing as well as a high quality polish, is the work done in the *laying shop*. The glass sheets should be so set on the tables that the surface of the latter is utilized as completely as possible, that no sheet is set higher or lower than the others and that the whole charge holds tightly to the table. As mentioned before the general policy is to produce in the casting hall, the largest possible rough glass sheets. However, defects in the glass, in casting and rolling, as well as breakage of sheets, make it necessary to deal with smaller ones of various forms, as well as large ones. There is then sufficient choice in the rough glass store, so to make up each setting, that the table surface is fully utilized. Fig. 164 for instance shows a setting as it may arise with a circular table of 33 feet diameter. In most rough glass fac-

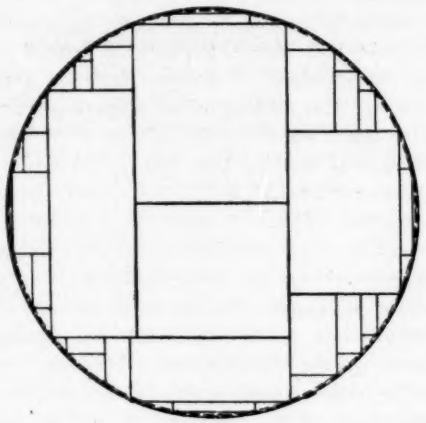

FIG. 164

tories the usual practice is to keep sheets down to 4 or 5 square feet as rectangles and to leave rough glass sheets which are too small for this purpose in triangular form. These so-called "corner pieces" are used in grinding shops for the filling up of the triangular areas round the periphery of the tables and only when they are finished (polished) are they cut to a rectangular form.

The gaps between the individual sheets are made as small as possible, but not less than $\frac{5}{16}$", so that the plaster therein does not break up in case the sheets move slightly during grinding or polishing or on account of the elasticity of the bottom plaster or the underlying cloth. Even very small areas on the table are filled up with small pieces of glass, as otherwise an unnecessary amount of expensive plaster must be used, while of the remelting value of the glass only that ground off on each side is lost; further, these small pieces can possibly be used for small articles; however a large plaster surface is detrimental to the polishing effect of the felts. If the smallest rectangular rough glass sheet is one of 4 sq. ft., 86 to 88 per cent of the whole surface of a circular table can be covered with glass, i.e., the surface of all rough glass sheets of 4 ft. size upwards represents 86-88 per cent of the table surface, about 7 per cent are covered by triangular sheets and the rest by plaster and fragments.

The laying out of a setting is done by specially trained men, the so-called "matchers." Formerly the settings were first tried on the shop floor on a round wooden board of the same size as the table surface; today they are sometimes drawn on paper to a scale of 1:50. This diagram, properly marked, accompanies the set right through to the ware room; on it are noted all details of the working cycle, the re-

sults of the grinding and polishing as well as breakage; also the time taken for grinding and polishing, the names of the matchers responsible, the laying gang, grinders, polishers, etc., so that the work can be checked at any time afterwards, the corresponding wages be paid, and the reasons for defects established.

To prevent, with circular tables, throwing off of the smaller sheets and the plaster near the edges, it was customary to provide along the table edge a number of ½" holes in which short wooden plugs were pushed, to which the plaster stuck tightly. Modern tables are provided at their

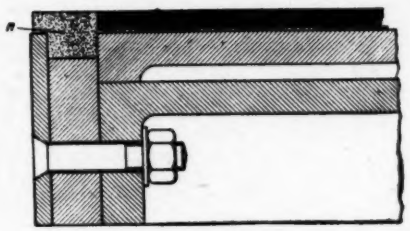

FIG. 165

edge with a groove n, Fig. 165, of 1 to 1¼" width and ⅜-⅝" depth, which when filled up with set plaster forms a key holding the whole body of plaster to the groove. Further, the plaster used for the edge is mixed with 10-15 per cent lime, causing a locally increased hardness and strength; Over the rest of the deck, in almost all factories, only pure plaster is employed, as it distributes itself better beneath the sheets and also comes off the glass and the iron more easily than a mixture does. Only the best quality and finely ground plaster is used; it is completely dry and feels like flour, contains no grains and is burned between 300 and 340° F., so that it sets completely within 20-30 minutes and without any appreciable belated growth. The best results are obtained with plaster coming fresh from the kiln. In the laying department it is made up with water to a liquid, uniform cream and poured over the table; the sheets are then laid on it and pushed down, being rocked at the same time, so that the liquid plaster rises between the edges of the sheets, leaving only a very thin layer, just sufficient to fill up any roughness between glass and table. When large sheets are laid, a number of men stand on them in order to trample the glass into the bed of plaster and force out air bubbles until it is level with adjacent sheets and lying tightly on the table. The plaster and water are mixed immediately at the table and the mixture is made up in one step, as otherwise the setting would proceed irregularly. The tighter the sheets hold to the table, the less water is required with the sand in grinding and with the rouge, in polishing, i.e., the sheets can be the more intensively worked and the grinding and polishing proceed quickly and cheaply. At various times suggestions have been made and tables designed where the sheets are sucked on to the table plate in order to avoid the use of the expensive plaster, but, so far they have not been successful.

In the laying of the various "sets" care must be taken that, in any one set, only flat sheets of equal thickness are taken, so that no sheets project above the others and none is set with its surface below the rest; of course it must also be watched that the sheet is not set higher on account of there being too much plaster beneath it. The more nearly level the whole charge is set, the quicker will be the grinding, the lower the grinding costs, the smaller the danger of breakage and the greater the output of the grinding shop. One single improperly set sheet will delay the grinding of the whole set. Sheets with humps and waves and sheets with uneven thickness are sorted out and arranged together in special settings. Before the sheets are set in the plaster they have again to be inspected for cracks which, in grinding, may cause breakage. Fire cracks in particular will extend and run to great distances owing to the appreciable heating up of the sheet during polishing.

The large sheets are carried on edge in straps from the rough glass store to the laying berths, or in modern works are conveyed by clamps suspended from electrically operated bridge-cranes, which put them against a vertical tipping table, whence they are picked up by the suckers of a suction crane and moved in horizontal position over the table and lowered thereon (b, e, f, Fig. 125).

Figs. 166 and 167 show a simple clamp, hanging from the hook of a crane, and shut by the bent lever action of the two toggles L. The clamp-faces are lined with wood and felt or rubber. When lowered down to the sheet edge, the clamp is opened by the action of the wood or rubber rolls B, which are held by a weak spring resting on the edge of the sheet and balancing the main weight of the clamp. The weight of the levers L and G causes the clamp to open. The chain is lowered until E comes in contact with the sheet. The clamp is now forced to shut and grip the sheet by lifting it with a crane and at the same time by pulling the bolt E downwards with a fork in order to overcome the force of the spring until the gripping is complete. With a careless or insufficiently trained operator, it may happen that he releases the clamp from the fork before it is gripping tightly; in this case the spring opens the clamp again and the sheet may fall. This is the reason why very often the spring is omitted altogether and the tong is opened by pushing a rod from below, so that the two grippers pass the sheet edge. For this operation a double fork D can be used, which is pressed towards the two arms of the bolt E.

(To Be Continued)

Macbeth-Evans Founds Fellowship at Mellon Institute

Dr. Edward R. Weidlein, director, Mellon Institute of Industrial Research, Pittsburgh, Pa., has announced that the Macbeth-Evans Glass Company, Charleroi, Pa., has established in that institution a Fellowship in illuminating glassware. According to Dr. Weidlein, the scientific investigations that will be conducted by this Fellowship will be forward-looking—a continuation along original lines and entirely independent of the technologic research that is carried on in the Macbeth laboratories. Dr. Rob Roy McGregor, a specialist in physical chemistry, has been appointed to the incumbency of this Fellowship.

The Wellman Engineering Company, Cleveland, O., announce that they have acquired by purchase the clam shell bucket and heavy-duty trailer business of the G. H. Williams Company of Erie, Pa., including their good-will, drawings, patterns, inventions, patents, etc., and that the engineering, manufacture and sale of these well-known Williams buckets and trailers has been transferred to the Wellman Engineering Company plant in Cleveland.

Glass Industry

ESTABLISHED 1920

The First Trade Journal Devoted Primarily to Glass Technology, Engineering, Raw Materials and Glass Factory Equipment and Operation

PUBLISHED MONTHLY

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GLASS INDUSTRY PUBLISHING COMPANY, INC.

24 West 40th Street, New York

Telephone CHickering 4—2354 Cable Address Glasdustry

G. W. Cooper, Managing Editor

Subscription Price.....$2.00 a Year
Single Copy .....20 Cents

For 1932

THOSE associated with THE GLASS INDUSTRY appreciate this opportunity of expressing to its readers their sincere hope that all shall enjoy

A Prosperous and Happy New Year

While still musing over the past year, why not look ahead for the next twelve months; how are they going to end?

Let's cooperate this year, all along the line, more actively than ever, each one striving continuously to be just, considerate and practically helpful to all with whom he comes in contact, either in business or socially, each of us thus conspiring, through the resultant favorable reactions to make his own next New Year's Day the most satisfactory he ever experienced.

Preaching, fortunately, has gone out of date; but this isn't preaching—it's just common sense which, put to practical uses, often produces desirable results.

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Rationalization

By Judson Bradley

Rationalization consists of: (1) Deciding what you want, (2) Studying the facts, (3) Organizing resources and facilities to the end desired.

I. What do we want? In the past the real want of most people has been personal and family success. To get ahead—with little care for the ruin of others—this has been the working ideal. We cannot achieve rationalization with this aim. *WELFARE FOR ALL!* This is the only worthy end.

II. What are the facts of our economic life? In good times 20 per cent of our people lack the barest necessities. Not 5 per cent of the American population obtains sufficient economic goods to satisfy reasonable wants. We do not begin to produce enough.

Meanwhile our industries are in a state of anarchy. Haphazard production; each concern trying to smash the others, enormous waste because of disorganization! Thirty per cent of our industrial equipment is idle in the best times and half of it is idle in bad times—while millions of people lack necessary goods!

Why is this? Because of their disorganization the industries of the country are in such a jam that they cannot function. Even in the "prosperous" year of 1928 nearly half of them lost money. (According to income tax returns).

III. How can we organize our means to the desired end? Rationalization can be effected only by persons whose sole aim is the social welfare, who are thoroughly acquainted with the facts, and who are highly intelligent and resourceful. Few people can meet these qualifications. The welfare of the race depends on a relatively few unselfish people of great knowledge who work out better ways of doing things. This is as true in social life as in medicine. Rationalization must be worked out by a few economic and social leaders who will unselfishly show the people what to do. The real leaders will have to get together and work out a better system or the race will go under. The masses will follow able, devoted leaders, but popular clamor, conventions and selfish factions will not solve national problems.

We suggest that rationalization of the country's industries requires:

1. Knowledge of the basic economic needs of the country
2. The proper amount of equipment to meet these needs.
3. The organization of this equipment so that it will work efficiently and without waste.

We suggest that each of the basic industries of the country be organized into a limited number of corporations preserving a certain amount of competition. That the industry as a whole, under the oversight of the Federal Trade Commission, plan a productive program, and control the installation of additional equipment. The controlling norms should be efficiency and a reasonable return to managers, workers and those who furnish the capital.

By rationalization we can get out of the depression. But rationalization can only be achieved by a new ideal that permeates our moral fibre: *WELFARE FOR ALL!*

Incandescent Lamp Sales in 1931

A new combined mercury-vapor and incandescent electric lamp unit for use in a windowless factory was one of the developments in the incandescent lamp manufacturing industry during the past year.

A preliminary estimate of the number of incandescent lamps sold in the United States during 1931 indicates a total of 557,400,000 for both large and miniature lamps, according to a review of the electrical industry prepared by John Liston for the *General Electric Review* for January.

The quantity included 349,450,000 large lamps with metal filaments, a new high record, and 203,100,000 miniature lamps with metal filaments. There was a decided drop in the sale of carbon-filament lamps, which accounted for less than one per cent of the total. These lamps included only 4,850,000 large and miniature bulbs, less than one-third the production in the previous year.

In the field of lighting, a number of new types of lamps were produced, some of them developed along conventional lines but others having distinctly new features. In addition to the lamps designed for the windowless factory there were new types of neon glow lamps for special applications; and ultraviolet producing lamps which are so designed as to permit their safe, continuous use without transformers on normal lighting circuits.

Glass Tiles

By ALEXANDER HOPKINS[1]

THE use of glass tiles as a finish for walls, floors and other parts of buildings and for decorative purposes has often proved unsatisfactory because of the excessive breakage resulting when tiles are closely confined at the edges and subjected to extreme temperature variations. Though long used, no completely successful method for cementing glass tile to brick or other supporting structures has been developed until now, when the cracking of the glass due to excessive expansion has been overcome by the use of a new plastic cement that adheres permanently to both the glass tile and the background with which it is placed in intimate contact.

There is no doubt that the lack of an entirely satisfactory cement in the past has greatly retarded a more extensive use of glass tile. Architect or builder sometimes hesitates to specify glass tile for certain purposes where less troublesome though perhaps not so good substitutes may be obtained. Lugs, corrugations or other devices protruding from the back of the tile and embedded in the cement when erected, only aggravate conditions when undue expansion of the tile is forced by any cause. The situation has been a bugaboo to the tile industry but the difficulties are beginning to give way, due to a new method of tile-laying developed by the writer of this article. With many years of practical experience in the applications of both glass and clay tile, he feels justified in presenting here his solution of this problem by a new process of tile construction which gives promise of opening up an important era in glass tile, decidedly more extended in its scope than heretofore, accompanied by a substantial reduction in installation costs.

The resiliency of the new cement provides for glass expansion and contraction, thus producing a safe covering for the inside and outside of structures, that resists the action of the elements indefinitely and the decay of time.

It is widely recognized by architects and builders that glass tile is superior in several ways to clay or marble tile. It does not craze, is non-absorbent, resists all acids except hydrofluoric acid, and is a very sanitary material, easily cleaned. It can be used on exterior as well as interior walls of structures. The old saying, "as hard as marble" is very misleading as most marbles are soft and very absorbent by nature. Marble is of a limestone formation and is seldom found in a pure state. Most of the veins in marble consist of foreign substances such as iron, etc. Impurities and defects are often hidden by the use of colored wax which sooner or later becomes detached, and the marble will show rusty streaks and defects as it disintegrates. Further, the polish on marble is produced by oxalic acid, which does not prevent absorption. Consequently, marble is not such a satisfactory or sanitary material as sometimes supposed.

[1] 297 Bowery, New York, N. Y.

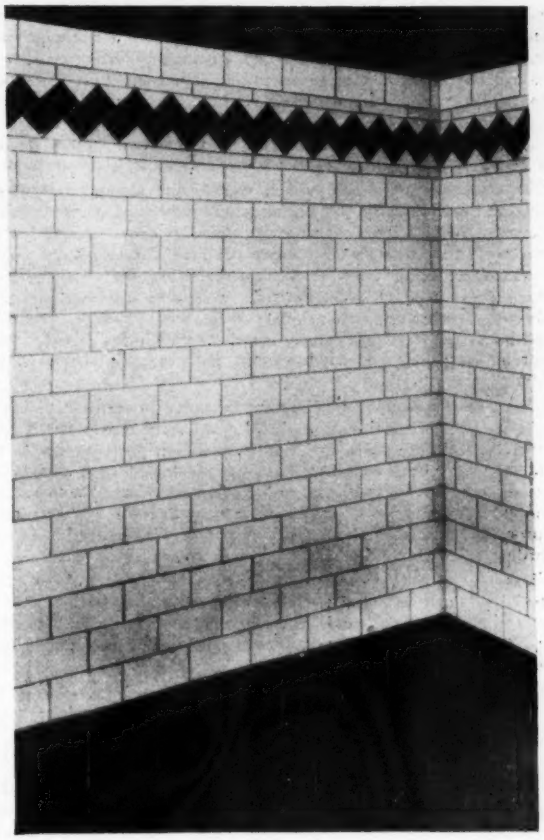


FIG. 1—GLASS TILE WORK COVERING 25 SQUARE FEET, USING 259 PIECES, WAS SET IN FOUR HOURS BY A NEW METHOD OF APPLICATION

Enameled clay tiles in time become crazed. This crazing consists of numerous minute cracks in the glaze or enamel that allow acid or moisture, etc., to enter the pores of the bisque bodies, again causing disintegration and destroying their sanitary qualities. Glass tiles are not subject to such defects.

Fig. 1 shows a section of bathroom walls of glass tile 6″ x 6″, black base, 6″ x 3″ white body, 6″ x 1″ cream strips, with 4½″ x 2⅛″ black set on the diagonal, and with 2⅛″ diagonal for

FIG. 2—GLASS TILES AS MADE ABOUT THIRTY YEARS AGO

border. The piece of work shown consists of over 25 square feet, using 259 pieces, and was set in four hours, using a method of application invented by the author and assuring permanency as well as a reasonable amount of production and highest grade workmanship. This method involves the setting of any size glass slabs or tiles from the largest to the most minute mosaics. This type of glass tile work and the amount of production cannot be duplicated by any of the present modes of application in use.

Fig. 2 shows glass tiles which were made about thirty years ago including variously shaped bases and caps, and parts designed to create round sanitary corners. These evidence the fact that the manufacture of such tiles is practicable. The two large pieces are embossed decorations sand blasted, giving the tiles the soft velvety surface effect often desired. Available also are essential bathroom accessories such as glass soap dishes, tumbler recesses, tooth-brush holders, door stops, towel racks, clothes hooks, toilet paper holders, door and window trim, push buttons, shelves, light holders, etc.

Glass tile is adaptable for innumerable uses in addition to bathrooms and acecssories, such as lavatories, vestibules, store fronts, inserts on building walls, and numerous other purposes involving many of the processes used in glass manufacturing such as rolling, pressing, curring, staining, enameling, burning, sand blasting, and so forth. An unlimited variety of designs and color effects may be produced by using a few sizes of geometrical shaped tiles cut according to correct principles.

Glass seems destined to become perhaps the principal building material of the future and the glass tile industry as well as architects, builders, owners and users of buildings will undoubtedly share liberally in the prosperity that will accompany its further development.

It Refuses to Expand![1]

New Ceramic May Be Utilized for Pyrometer Tubes

Engaged in the unique task of developing special ceramics for specific and scientific requirements, Henry L. Crowley, of West Orange, N. J., took upon himself the task of evolving a material of still lower coefficient of expansion than Invar, an alloy heretofore representing the lowest thermal coefficient. He sought his solution in the field of ceramics rather than metals and alloys, and finally evolved an entirely new formula known as Crolite No. 7 with a coefficient of but one-fourth that of sillimanite at 100 deg. C. and with a two to one advantage at 1000 deg. C. Thus Crolite No. 7 becomes the lowest coefficient, the factor that has made the latter the choice for low thermal expansion applications such as spark plug cores.

Moreover, Crolite No. 7 expands only about half as much as Invar, a metal whose coefficient is still lower than that of sillimanite. This places a ceramic rather than a metal at the head of the list of low expansion materials. Porous zircon, magnesium silicate, fused alumina, and rutile are high when compared with Crolite No. 7. At the high temperature of 1000 deg. C., the new ceramic expands considerably less than three-tenths of one per cent.

Crolite No. 7 can withstand violent heat shock, such as heating to incandescence followed by plunging in water, without destruction. Processes formerly impracticable due to the non-existence of a material of sufficiently low coefficient of expansion may now be carried on, it is stated, with the aid of this new ceramic.

LOW TEMPERATURE RANGE 0-200 DEG. C.

Hermsdorf Porcelain	4.25	(0-200 deg. C.)
Sillimanite	4.19	(30-400 deg. C.)
Pyrex	3.2	(19-350 deg. C.)
Alundum	7.1-8.5	(100 deg. C.)
Carborundum	6.58	(100 deg. C.)
Invar	1.5	(0-100 deg. C.)
Crolite No. 7	.9	(0-100 deg. C.)
Crolite No. 7	1.2	(0-200 deg. C.)

HIGH TEMPERATURE RANGE 0-1000 DEG. C.)

Crolite No. 7	2.70	(0-1000 deg. C.)
Sillimanite	4.98	(0-1000 deg. C.)
Mullite	5.2	(0-1000 deg. C.)
Magnesium Silicate Type	8.3	(0-1000 deg. C.)
Rutile	8.85	(0-1000 deg. C.)

[1] Abstract from report submitted by Austin C. Lescarboura, Henry L. Crowley & Company.

The new ceramic has certain critical applications, such as in precision instruments where changes of material must not upset characteristics. Also, it may be employed for spark plug cores and other uses, particularly pyrometer tubes, where heat shock is severe.

For those preferring precise comparative data, the following tables are presented, covering a low temperature and a high temperature range, and indicating coefficients for different materials.

A Ceramic Material of Low Thermal Expansivity

In volume 10 (June, 1929) and volume 11 (February, 1930) of the Ber. der Deut. Ker. Gesell., W. M. Cohn presents the results of thermal expansion determinations on a ceramic body having the remarkably low coefficient of thermal expansion of 0.53×10^{-6} (106 parts per 1,000,000) in the temperature range 0° to 200° C. His results indicate a slight contraction reaching a maximum of about 10 parts per 1,000,000 at approximately 70° C., after which the material expands at a gradually increasing rate. A typical body composition was given as 43 per cent steatite, 35 per cent Zinzendorfer clay, and 22 per cent anhydrous Al_2O_3.

To duplicate these interesting results a body was prepared of 43 per cent talc, 35 per cent kaolin from Florida, and 22 per cent corundum, and subjected to a number of different heat treatments. Not only were expansions obtained similar to those found by Cohn, but it was possible to establish the fact that the low expansivity is a characteristic of one form of the mineral cordierite ($2MgO.2Al_2O_3.5SiO_2$). The formation of this compound apparently proceeds very slowly at 1,350° C. and with increasing rapidity at higher temperatures up to approximately 1,450° C. where dissociation begins. Contraction below 100° C. was noted only for certain specimens made with talc as the source of the MgO. The smallest length changes noted were those of the talc body heated for three days at 1,350° C. and were as follows (given in parts per million): 60° contraction of 15 parts; 203° expansion of 63 parts; 402° expansion of 301 parts. Specimens made of reagent quality materials in the cordierite ratio, heated 20 minutes at 1,415° C. and containing approximately 90 per cent of the ternary compound, showed the following expansions: 60°, 15 parts; 140°, 80 parts; 200°, 160 parts. The same specimens, if held for some hours at 950° C., apparently invert to the form described by Rankin and Merwin as unstable (A. J. Sci., vol. 195, p. 45; 1918) and the thermal expansion has been increased to 415 parts per 1,000,000 at 200° C. However, reheating at 1,350° to 1,400° C. causes reversion to the low expanding form.

The magnesium silicates, forsterite, and clinoenstatite, undergo very large length changes when heated, the former being higher than that of corundum, and these are in turn exceeded by the expansion of a α CaO. SiO_2 which was 2,020 parts per 1,000,000, at 200° C. The expansion of ortho zinc silicate is surprisingly low, 389 parts at 295° C., and preliminary tests of natural beryl indicate that this material may have a thermal dilation lower than that of cordierite.—*Tech. News Bull., No.* 176, *Bur. of Stds.*

Notice of Reduction in Window Glass Tariff

The United States Tariff Commission has reissued a notice, corrected, which originally appeared in Commerce Reports December 14 1931 (pp. 642-643), relating to the Tariff Commission report on window glass and the issuance of a proclamation by the President prescribing a reduction of 25% in the present rates of duty. The notice covers glass as described in paragraph 219 of the Tariff Act of 1930 and consists of three types distinguished by the thickness or weight of the glass namely:

(a) thin glass weighing less than 16 ounces per square foot
(b) common window glass which consists chiefly of single strength glass weighing from 16 to 18 ounces per foot, and double strength glass weighing about 24 ounces per square foot.
(c) heavy sheet glass weighing 26 ounces or more per square foot which is chiefly used for automobiles and for glass showcases.

The report also gives information regarding the domestic production of window glass from its peak year 1925 down to the present and a statement covering the distribution of domestic window glass sales throughout the country. Imports are consumed mostly in the ports of entry. In 1929 New York received about 28 per cent and San Francisco 23 per cent of total imports from Belgium.

A Slide-Rule for Estimating Tonnage from Automatic Feeders

By S. R. SCHOLES[1]

IT is often desirable to estimate closely the quantity of glass drawn from a tank equipped with automatic machines supplied by flow-spouts or feeders.

Many of us have been using a formula derived as follows:

$$\frac{\text{Shear-cuts per minute} \times \text{Ounces per shear-cut} \times 1440 \text{ (min. per day)}}{16 \times 2000} = \text{Tons per day}$$

Which becomes, by cancellation:

$$\text{Shear cuts per minute} \times \text{Ounces per shear-cut} \times \frac{9}{200} = \text{Tons per day}$$

The slide-rule illustrated herewith is designed to perform this arithmetical operation with one setting. The lower scale is laid off in the logarithms of the ounce-numbers, and the middle scale, the sliding member, in the logarithms of the shear-cut-numbers, beginning for convenience with 10. The upper scale corresponds to the logarithms of 9/20 of the tons. This performs the operation of multiplying by the constant factor once for all, and since the slide is to be set with its "10" line on the ounce number for each operation, the constant multiplier becomes 9/20 instead of 9/200.

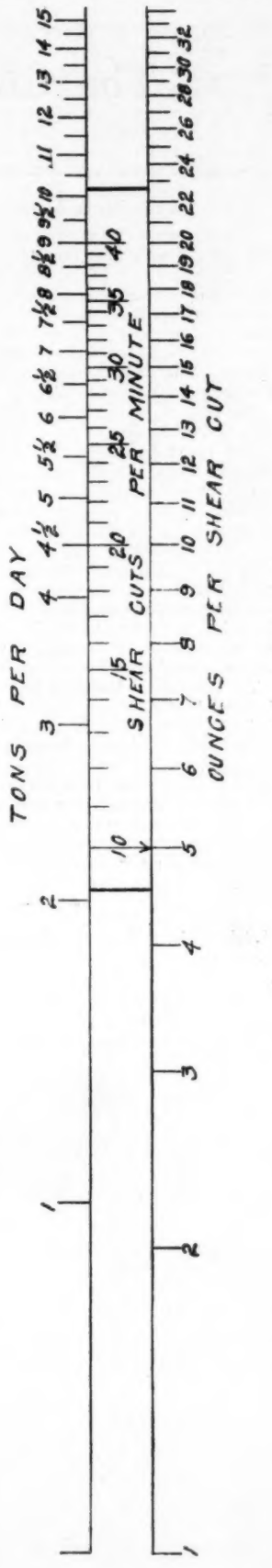
In use, the sliding member is adjusted so that its "10" line coincides with the proper number of ounces on the lower scale. The line on the sliding member representing the shear-cuts per minute on the feeder in question then coincides with the number of tons of glass fed per day, read from the top scale.

For example, in the setting illustrated, a 5-oz. gob is being fed; if the shears operate 30 times per minute, the tonnage is read where the 30-line on the slide meets the upper scale at 6¾.

It is obvious that unusually high gob-weights or low shear-cut numbers may be handled by taking half the weight or twice the shear-cut number, and multiplying or dividing the tonnage result accordingly.

By cutting out and cutting apart the illustration and pasting the pieces to suitable strips of wood, metal, or other suitable material, a working slide-rule may be assembled.

The publishers of THE GLASS INDUSTRY will supply reprints of this page to any who request them, at nominal cost.



[1] Federal Glass Company, Columbus, O.

(Copyrighted)

The Glass World and What It Is Doing

News of the Industry

Prominent Instrument Lines Merge

The Pyrometer Division of the Wilson-Maeulen Company, Inc., has merged with The Foxboro Company. This action has followed twenty-five years of close and friendly co-operation between the two companies, and was made wholly in the interest of better service by thus being able to offer complete instrumentation to Industry. The many users of Wilson-Maeulen Pyrometers will be served by a larger, more widespread group of instrument engineers. The announcement was made by the Wilson-Maeulen Company on December 8.

The logic of greater future effectiveness has been the sole dictation of the decision.

The entire personnel of the Pyrometer Division of Wilson-Maeulen Company will be merged with that of The Foxboro Company. It is felt that this combining of the knowledge and experience of these two organizations will prove an important step in the progress of this industry.

This merger has a significance beyond that of greater facilities. The Wilson-Maeulen Company specializes in the manufacture of electric indicating, recording and controlling pyrometers and electric resistance thermometers for temperatures up to 3600° F. Thus, by including the outstanding Wilson-Maeulen Temperature instruments, The Foxboro Company can now offer a complete range of instruments of standardized quality.

The well-known Rockwell Hardness Tester that has been manufactured by the Wilson-Maeulen Company will hereafter be built and sold by the Wilson Mechanical Instrument Company which succeeds the Mechanical Instrument Division of Wilson-Maeulen Company, Inc., and continues in the same factory and offices at 385 Concord Avenue, New York.

The Wilson-Maeulen pyrometers and controllers will be built in the modern, excellently equipped factories at Foxboro. All communications relative to pyrometers should be addressed to—Wilson-Maeulen Pyrometer Division, The Foxboro Company, Foxboro, Mass.

Miller Firm Reports Exceptionally Prosperous Year

The Miller Machine & Mold Works, Columbus, O., through A. G. Doll, secretary and treasurer, reports that the year ending with December has been the banner year of their existence as regards the amount of business transacted. Part of the time their plant has been running night and day and at last reports was still

operating full time and full force. Both Edward Miller, head of the firm and Mr. Doll are optimistic regarding the possibilities of their continuing during the coming year on the same or even a higher scale of production than the year just completed. "We are still going along," said Mr. Doll, "with plenty of orders on our books, which we will agree with you is, as Amos and Andy would say 'Aint dat Sumpin?' We have not really experienced any depression."

The Miller Machine & Mold Works adopted some time ago for a trade mark a picture of a miller with wide-spread wings, which appears in a light tint on the Company's letterheads. This miller has often been mistaken for a butterfly by careless observers or those not thoroughly informed on the butterfly species. It is not a butterfly but a miller which is the reason for its adoption as a unique trade mark by the Miller Company. In order to make it plain just what this trade mark is we are showing it herewith.

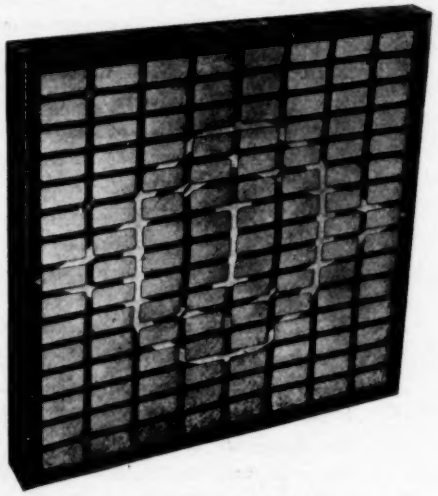
The company recently distributed to each of various friends a complete set of pressed glass luncheon ware made on a Miller Machine. An opportunity was given to the Miller employes to purchase sets at a very low cost and many of them availed themselves of obtaining a supply for themselves and their relatives and friends.

Owens-Illinois Glass Company Announces "Dustop"

A Novel Use for Glass Wool

The Owens-Illinois Glass Company, Toledo, organized some seventy-five years ago as a glass container manufacturer, and today one of the largest glass manufacturers in the world, after long study and laboratory research into the requirements of industry, announces "Dustop" air filter.

Realizing the ever increasing demand for clean air, made necessary through the congestion of our cities and dusty manufacturing operations, Owens-Illinois offers "Dustop" as a complete, self-



THE NEW "DUSTOP" AIR FILTER

contained air filter unit, in which "glass wool," specially treated with a dust catching coating, serves as the filtering medium.

"Dustop" is extremely simple of design and is so low in price as to make feasible the replacement of the complete unit when dirty. The replacement of a dirty unit is very easily and simply accomplished, no cleaning whatsoever being necessary.

This air filter unit is of unique design in several respects. The container is of paper, which adds to the lightness of the unit and renders it readily disposable. While it weighs but two pounds, it will absorb dust in excess of its own weight. The "flexibility" of the paper container establishes a tight seal between the filter and the metal frame into which it fits, thus preventing the passage of any unfiltered air around the unit.

With a view toward effecting further economies in the use of this air filter, it has been designed 2" in thickness, so that when a standard 4" pack is established by using two units in tandem, or two units placed face to face, it is only necessary to change one-half the thickness of the total pack at one time.

The device shows extremely low resistance and has proved to be exceptionally efficient. Two units in tandem will remove 99 per cent and more of the dust from the air.

In offering "Dustop" the Owens-Illinois Glass Company makes a contribution to industry and to the home in the interest of clean air at the lowest possible cost, and with a unit in which the servicing factor is reduced to a minimum

Next Month All Glassmen's Roads Will Lead to Washington

Although the detailed program of Glass Division activities at the annual meeting of the American Ceramic Society at Washington, D. C., has not yet been issued, a schedule of planned daily activities during the week has been charted. The annual meeting will begin on Sunday, February 7, when the trustees will meet in the Gridiron Room. On Monday morning, February 8, they will again meet and the Fellows of the Society will meet in the afternoon in the Cabinet Room. On Monday evening, February 8, the Materials and Equipment Division will frolic and dance at the Washington Hotel, Rose Room, 9 p.m. (Purdy's 50 daughters dancing). On Tuesday morning, February 9, the Glass Division will hold its first meeting in the Cabinet Room. Meetings at the same place will also be held on the mornings of Wednesday, February 10, and Thursday, February 11. The Refractories Division will likewise meet on the mornings of February 9, 10 and 11 in the large Ball Room. The Art Division's meeting will be held on Tuesday, February 9, in the Fairfax Room, and the Materials and Equipment Division will also meet on the same day in the President's suite. Tuesday afternoon a trip to the United States Bureau of Standards is scheduled. A general meeting will be held on the evening of Tuesday, February 9, at the Willard Hotel. Wednesday evening the Glass Division reception will be held at the same place. Wednesday noon a reception by President Hoover is scheduled to be followed by a trip to Mt. Vernon.

Divisional dinners will be held Wednesday evening, February 10, at 7 to 9:30 p.m., followed by President Eskesen's reception and general dance to be held the same evening at 9:30 to 1 a.m. Optional trips are scheduled to galleries, institutes, and the cathedral as elected. On Thursday, February 11, at 7 p.m. school and group dinners will be held. Those going on the sight-seeing trip to Baltimore will leave for that city 9:10 a.m. Friday, February 12.

Further information may be obtained from R. J. Geller, U. S. Bureau of Standards, Washington, D. C.; L. J. Trastel, General Refractories Company, Box 935, Baltimore, Md.

Ultra-Violet Agricultural Glass

In view of the inquiries received at the U. S. Bureau of Standards as a result of the increased sales promotion of "Agricultural Window Glass," etc., for use in hen houses and other animal houses, the following information may be of interest.

The term "agricultural glass" is a misnomer that is subject to misunderstanding and open to misrepresentation of the product.

As presented to this bureau it represents a window glass made especially for transmitting ultra-violet solar rays of wave lengths 302 millimicrons and shorter. It is in reality a grade C or very poor grade B of this special glass, that contains optical flaws which make the glass unsightly in dwellings and solariums but which has practically the same ultra-violet transparency as grades A and B.

It is well known that the ultra-violet transparency of the different melts of these special window glasses is variable. Hence it is possible for "agricultural glass" to become the dumping ground for the poorer melts of ultra-violet transmitting glass.

It is interesting to note that much of the present-day sales promotion of these special window glasses for use for healing human beings, is based upon experiments originally performed upon chicks, white rats, and other animals. Attention is therefore called to a report to the council of physical therapy of the American Medical Association (J. A. M. A., vol. 88, p. 1562; May 14, 1927) showing that a transmission of 30 per cent at 302 millimicrons is required in order to insure that the amount of ultra-violet passing through the glass will be effective. Glass that transmitted only 5 per cent at 302 millimicrons gave no protection from rickets and in this particular test even the 30 per cent transmission did not effect a 100 per cent cure of rickets.—*Tech. News Bull. No. 176, Dec.*, 1931.

Attack Unethical Advertising

A meeting of a Committee on Predatory Practices in Advertising was held at the Pennsylvania Hotel, New York, about the middle of December for the purpose of starting a nation-wide campaign against unfair and misleading advertising. According to Chairman Flint Grinnell, manager of the Chicago Better Business Bureau, predatory practices "are no longer matters simply of business ethics but must be considered economically unsound and a serious handicap to legitimate business." Among the concerns backing this movement are many prominent department and drug stores and many well known advertising men. The affiliated Better Business Bureaus throughout the country are also cooperating.

Coming Meetings

Glass Division, American Ceramic Society, Washington, D. C., February 11 to 17, Hotel Willard.

Glass and Pottery Show, Pittsburgh, 51st Annual Exhibit, January 11-21, Fort Pitt and William Penn Hotels.

Inquiries Received

For further information address THE GLASS INDUSTRY.

564. (From a large Japanese company). We were interested to learn in Dr. Preston's article "Physics in the Glass Industry" that Pyrex Glass in the form of tubing, pipes, etc., is being applied extensively to industrial uses. We have long been wanting such glass and would thank you to send us the manufacturer's address.

Readers Wants and Offers

Address answers to all "keyed" ads c/o The GLASS INDUSTRY, 24 West 40th St., New York

WILL PAY REASONABLE PRICE
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THE GLASS INDUSTRY
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CABLE ADDRESS "SHARPGLASS" HAMBURG, N. Y. U. S. A.

Current Prices of Glass-Making Materials

December 22, 1931

Quotations furnished by various producers, manufacturers and dealers

		Carlots	Less Carlots
Acid			
Citric (dom.)	lb.	..	.33½
Hydrochloric (HCl) 20° tanks, per 100 lb		..	1.10
Hydrofluoric (HF) 60% (lead carboy)	lb.	..	.13½
52% and 48%	lb.	.10	.10-.11½
Nitric (HNO_3) 38° carboy ext. Per 100 lb.		5.50	..
Sulphuric (H_2SO_4) 66° tank cars	ton	15.50	..
Tartaric	lb.	..	.26½
Alcohol, denatured	gal.	..	..
Aluminum hydrate ($Al(OH)_3$)	lb.	.04½-.05	.05½-.06
Aluminum oxide (Al_2O_3)	lb.	..	.07
Ammonium bifluoride (NH_4) FHF	lb.	..	.15½
Ammonia water (NH_4OH) 26° drums	lb.	..	..
Antimony, metallic (Sb)	lb.	.02½	.02¾
Antimony oxide (Sb_2O_3)	lb.	..	.09¾
Antimony sulphide (Sb_2S_3)	lb.	..	.08½
Arsenic trioxide (As_2O_3) (dense white), 99%	lb.	.04	.14 .04½
Barium carbonate ($BaCO_3$), Crude, (Witherite) 90%, 99% through 200 mesh	ton	47.00	..
90% through 100 mesh	ton	44.00	..
Barium hydrate ($Ba(OH)_2$)	lb.	..	.05¼
Barium mixture, glassmaker's, f.o.b. St. Louis	ton	25.00	..
Barium nitrate ($Ba(NO_3)_2$)	lb.	..	.07¼
Barium selenite ($BaSeO_3$)	lb.	..	..
Barium sulphate, in bags	ton	19.00	24.00
Barium sulphate, glassmaker's, carlots, bulk, f.o.b. shipping point,	ton	15.00-16.00	18.00
Bone ash	carlots, lb.	.06	.06½
Borax ($Na_2B_4O_7 10H_2O$)	lb.	..	.0355-.0425
Crystal	lb.	.028-.033	..
Granulated	lb.	.025-.03	..
Powdered	lb.	.02375-.03375	..
Boric acid (H_3BO_3)	lb.	.0625-.07125	.0625-.08125
Refined	lb.	0625-.07125	.07125-.08125
Cadmium sulphide (CdS)—			
Red	lb.	..	.65-.90
Orange	lb.	..	.60-1.10
Yellow	lb.	..	1.30-1.50
Chromium oxide (Cr_2O_3)	lb.	.23	.24
Cobalt oxide (Co_2O_3)			
In bbls.	lb.	..	1.35-1.45
In 10 lb. tins	lb.	..	1.45
Copper oxide			
Red (Cu_2O)	lb.	..	.25
Black (CuO)	lb.	..	.17-.19
Black prepared	lb.	..	.22
Cryolite ($Na_3Al F_6$) Natural Greenland Kryolith)	lb.	.09	.09¼
Synthetic (Artificial)	lb.		.09½
Epsom salts ($MgSO_4$) (imported) Per 100 lb		..	1.15-1.20
*Feldspar—			
100 mesh	ton	11.50-17.50	12.00-18.00
80 mesh	ton	11.00-11.50	13.00
40 mesh	ton	10.75-11.00	12.00
20 mesh	ton	9.50- 9.75	10.00
Fluorspar (CaF_2) domestic, ground, 96-98% (max SiO_2 2½%)			
Bulk, carloads, f.o.b. mines	ton	30.00	..
In bags or barrels	ton	34.00	39.00
Imported	ton	30.00-31.00	33.00-37.00
Formaldehyde	lb.	..	.07
Graphite (C)	lb	..	.04-.07
Iron oxide—			
Red (Fe_2O_3)	lb	..	.0425
Black (FeO)	lb	.04½	..
Kaolin (f.o.b. mine)	ton	8.00-9.00	..
English, lump, f.o.b. New York	ton	14.50-25.00	24.50-30.00
Kryolith (see Cryolite)		Carlots	Less Carlots
Lead chromate ($PbCrO_4$)	lb.	..	30
Lead oxide (Pb_3O_4) (red lead)	lb	.0625	.0725
Litharge (PbO)	lb.	.0525	.0625
Lime—			
Hydrated ($Ca(OH)_2$) (in paper sacks)	ton	6.50	..
Burnt (CaO) ground, in bulk	ton	5.50-6.00	..
Burnt, ground, in paper sacks	ton	7.50-8.00	..
Burnt, ground, in 280 lb. bbls.	Per bbl.	2.15	..
Limestone ($CaCO_3$)		1.50-2.50	..
Magnesia (MgO)—			
Calcined, heavy (in bbls.)	lb	.06	.07
light (in bbls.)	lb.	..	.23
extra light (in bbls.)	lb.	..	.37
Magnesium carbonate ($MgCO_3$)	lb.	.06	.10
Manganese 85% (MnO_2)	lb.	.03	.03
Nickel oxide (Ni_2O_3), black— for nickel content	lb	..	.35
Nickel monoxide (NiO), green— for nickel content	lb	..	.35
Plaster of Paris, bags	ton	21.00	23.00-29.00
Potassium bichromate ($K_2Cr_2O_7$)—			
Crystals	lb.	.09	.09¼
Ground	lb.	.11	.12
Potassium carbonate—94-96%	lb.	.0555	.0555
Calcined (K_2CO_3) 96-98%	lb.	.06¼	.07
Hydrated 80-85%	lb.	.05¾	.06¼
Potassium chromate (K_2CrO_4)	lb.	..	.25
Potassium hydrate (KOH) (caustic potash)	lb.	.07¼	.08
Potassium nitrate (KNO_3) (gran.)	lb.	..	.06-.06¼
Potassium permanganate ($KMnO_4$)	lb.	.16	.17
Powdered blue	lb.	..	.17½-.18
Rochelle salts, bbls.	lb.	..	.16½-
Rouge	lb.	..	..
Rutile (TiO_2) powdered, 95%	lb.	.15-.20	.20-.25
Salt cake, glassmakers (Na_2SO_4)	ton	22.00	..
Selenium (Se)	lb.	..	1.80
Silver nitrate ($AgNO_3$)	(100 oz.) per oz.	..	.23¾
Soda ash (Na_2CO_3) dense, 58%—			
Bulk, on contract	Flat per 100 lb.	1.05	..
In barrels	Per 100 lb.	1.38	1.90-2.00
In bags	Per 100 lb.	1.17½	1.72½
Spot orders.. .025 per 100 lbs. higher		..	..
Sodium bichromate ($Na_2Cr_2O_7$)	lb.	.07	.07½
Sodium hydrate (NaOH) (caustic soda) Solid	Per 100 lb.	2.50	..
Sodium nitrate ($NaNO_3$)—			
Refined (gran.) in bbls.	lb.	..	..
95 per cent	Per 100 lb.	1.67-177	1.72-1.82
Sodium selenite (Na_2SeO_3)	lb.	..	2.00
Sodium fluosilicate (Na_2SiF_6)	lb.	.04	.04½
Sodium uranate (Na_2UO_4) Yellow or Orange	lb.	..	1.50-1.55
Sulphur (S)—			
Flowers, in bbls	Per 100 lb	3.45	3.80-4.00
Flowers, in bags	Per 100 lb	3.10	3.45-3.65
Flour, heavy in bbls	Per 100 lb	2.85	3.20-3.40
Tin chloride ($SnCl_2$) (crystals)	lb	.37½	.39
Tin oxide (SnO_2) in bbls	lb	.28	.29½
Uranium oxide (UO_3) (black, 96% U_3O_8) 100 lb. lots. Black	lb.	..	2.75
Yellow	lb.	..	1.50
Zinc oxide (ZnO)	lb.	.08½	.12
American process. Bags	lb.	.06½	.07
Zircon			
Granular (Milled .005-.02c higher)		.07	.07½-.08
Crude. Gran. (Milled .005-.02c higher)		.03¼	.04-.05

*Spot Shipments.

Monthly Summary of United States Foreign Commerce in Glass

EXPORTS

Corrected to November 25, 1931

	October 1930 Quantity	October 1930 Value	October 1931 Quantity	October 1931 Value	Ten Months Ending October 1930 Quantity	Ten Months Ending October 1930 Value	Ten Months Ending October 1931 Quantity	Ten Months Ending October 1931 Value
Glass and glass products (Total)	.....	$780,883	.....	$461,972	.....	$7,821,758	.....	$5,975,202
Plate and window glass—								
Window glass, common, box 50 sq. ft.	263	1,404	921	3,426	14,347	78,258	7,259	34,921
Plate glass, unsilvered, sq. ft.	275,201	90,461	230,544	66,332	2,868,197	891,416	3,168,272	958,880
Other window and plate glass lbs.	524,291	43,467	241,053	22,043	4,623,196	393,739	2,481,476	252,409
Glass containers (bottles, vials and jars)	.....	209,676	.....	136,664	.....	2,590,046	.....	1,812,656
Table glassware, plain	.....	128,510	.....	59,794	.....	1,016,601	.....	764,130
Table and other glassware, cut or engraved	.....	8,977	.....	4,132	.....	80,394	.....	68,423
Lamp chimneys and lantern globes lbs.	.....	13,751	.....	3,317	.....	190,686	.....	75,102
Globes and shades for lighting fixtures lbs.	.....	48,020	.....	31,602	.....	501,704	.....	350,946
Chemical glassware lbs.	39,513	23,649	16,723	15,997	228,016	198,464	130,924	128,158
Electrical glassware, except for lighting lbs.	281,402	22,941	30,331	2,804	3,297,512	224,924	1,149,671	75,805
Other glassware	.....	190,027	.....	115,861	.....	1,655,526	.....	1,453,772

IMPORTS

Corrected to November 25, 1931

Glass and glass products	.....	$774,034	.....	$749,975	.....	$7,647,254	.....	$5,505,964
Cylinder, crown, and sheet—								
Plain dut. lb.	859,814	33,884	705,553	20,830	13,568,376	531,893	6,966,968	264,603
Bent, beveled, colored, etc. dut. lb.	238,891	23,624	153,493	22,250	.....	301,730	1,535,587	215,821
Plate glass dut. sq. ft.	481,957	96,795	347,896	59,344	4,735,773	1,007,731	4,153,081	992,219
Glass mirrors	24	183	.....	.....	[2]401	[2]886	1,407	3,407
Rolled, cylinder, crown, and sheet glass, ground, obscured, bent, beveled, colored, etc.	.....	4,995	.....	19,069	.....	[2]18,749	.....	80,116
Laminated glass and manufactures, and plated glass	.....	1,716	.....	1,237	.....	[2]12,340	.....	17,136
Bottles, vials, jars, and other containers	.....	79,931	.....	65,687	.....	993,600	.....	448,779
Scientific articles and utensils dut.	.....	38,377	.....	27,603	.....	448,462	.....	344,426
Tubes and rods dut.	.....	8,872	.....	6,526	.....	[2]31,545	.....	108,416
Illuminating articles dut.	.....	54,983	.....	9,076	.....	511,669	.....	313,932
Blown glass articles—								
Bulbs for electric lamps, without filament dut.	.....	.....	1,001,868	7,696	.....	.....	10,807,722	99,328
Other blown glass articles dut.	.....	.....	.....	374,309	.....	.....	.....	1,746,382
Pressed glass articles	.....	29,605	.....	16,037	.....	178,555	.....	103,776
Other glassware	.....	101,199	.....	90,311	.....	934,575	.....	767,623

[2]Beginning June 18, 1930.